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TABLE OF THE WAITING TIME DISTRIBUTION
FOR THE CONSTANT SERVICE QUEUE (M/D/1)

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AS AD NO.

by

Robert M. Oliver
Operations Research Center
University of California, Berkeley

OPERATIONS RESEARCH CENTER

INSTITUTE OF ENGINEERING RESEARCH

UNIVERSITY OF CALIFORNIA - BERKELEY

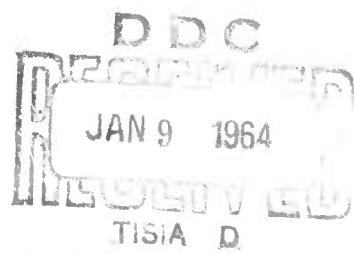
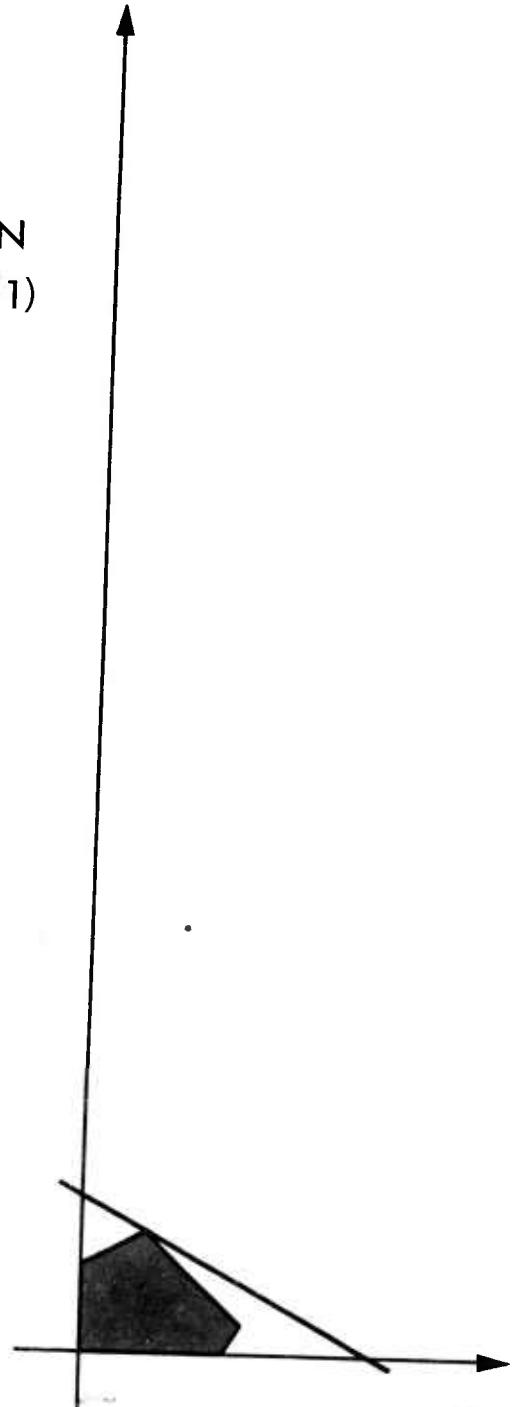


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FOR THE CONSTANT SERVICE QUEUE (M/D/1)

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TABLE OF THE WAITING TIME DISTRIBUTION
FOR THE CONSTANT SERVICE QUEUE (M/D/1)

1. Introduction

The single-channel constant service queue with Poisson arrivals represents one of a variety of mathematical models where customers demand service at a single facility. In this model it is assumed that the times between arrivals are exponentially distributed random variables and that the service or holding time of each customer is a constant Δ ; hence, a completion of service occurs every Δ time units when there are customers in the service facility. Tables of the probability distribution that the wait in queue is less than or equal to a given value have been computed.

There is an extensive list of publications covering the general theory of queues and the special cases of constant service times. The reader is referred to original papers on the constant service queue by Crommelin⁽¹⁾, Erlang⁽²⁾, Fry⁽³⁾, Khintchine⁽⁴⁾, and Pollaczek⁽⁵⁾.

2. Theoretical Considerations

Denote the wait (in queue) of two successive arrivals into a single service facility by the random variables x and y . Arrivals are served one at a time (in order of arrival) at constant intervals Δ when the service facility is busy; i.e., when there are a positive number of customers in the service facility. If the service facility is empty, an arrival has no wait in queue and immediately begins his constant service time. If the time between arrival of the first and second customer exceeds the wait in queue plus constant service time of the

first customer, $x + \Delta$, the wait of the second customer is $y = 0$. Otherwise, the wait of the second customer is $y = x + \Delta - u$, where u is the random inter-arrival time. The distribution of y is the distribution of the positive part of $x + \Delta - u$,

$$y = \text{Max} (0; x + \Delta - u). \quad u \geq 0 \quad (1)$$

If we assume that u has an average value λ^{-1} , and that, in equilibrium, $\Pr \{x \leq t\} = \Pr \{y \leq t\} = W(t)$, we obtain

$$\begin{aligned} W(t) &= \int_0^{\infty} \lambda e^{-\lambda u} W(t + u - \Delta) du & t \geq 0 \\ W(t) &= 0 & t < 0 \end{aligned} \quad (2)$$

Differentiation with respect to t and an integration by parts gives $W(t)$ as the solution of the differential-difference equation,

$$\frac{dW}{dt} = \lambda[W(t) - W(t - \Delta)]. \quad t > 0 \quad (3)$$

In terms of its Laplace transform,

$$W^*(s) = \int_0^{\infty} e^{-st} W(t) dt = \frac{W(0^+)}{s - \lambda + \lambda e^{-s\Delta}} \quad (4)$$

The boundary condition at $t = 0$ is obtained by requiring that $W(t)$ be an honest probability distribution; i.e., that $W(t) \rightarrow 1$ as $t \rightarrow \infty$ and that

$$\lim_{s \rightarrow 0} s W^*(s) = 1 \quad (5)$$

From this limit we obtain the probability that a random arrival does not have to wait,

$$W(0^+) = 1 - \rho \quad (6)$$

where $\rho = \lambda \Delta$ is called the fractional utilization of the service system; the requirement for statistical equilibrium is that $\rho < 1$; i.e., that average arrival rate be less than the average service rate.

Inversion of the Laplace transform in (4) can be made in several ways. A partial fraction expansion of $W^*(s)$ gives

$$W(t) = 1 - \sum_k \alpha_k e^{\beta_k t} \quad (7)$$

where β_k ($\operatorname{Re}\beta_k < 0$) are the distinct roots of

$$s - \lambda + \lambda e^{-s\Delta} = 0 \quad (8)$$

and

$$\alpha_k = (1 - \rho) (\rho e^{-\beta_k \Delta} - 1)^{-1}$$

An asymptotic expansion for $W_c(t) = 1 - W(t)$ can also be obtained in terms of the larger real root, z_0 , of

$$ze^{-z} = \rho e^{-\rho} \quad (9)$$

By substituting $z = \rho - s\Delta$ into Equation (4) we obtain

$$W^*(z) = \frac{\Delta (1 - \rho) e^{-z}}{\rho e^{-\rho} - ze^{-z}}$$

We now make use of the Laplace transform pairs

$$\begin{aligned} f(t) &\longleftrightarrow f^*(s) \\ b^{-1} e^{-at/b} f(t/b) &\longleftrightarrow f^*(a + bs) \end{aligned} \quad (10)$$

to obtain an asymptotic expansion for the probability $w_c(t)$ that the delay exceeds t ;

$$w_c(t) = 1 - w(t) \approx \frac{(1 - \rho)e^{(\rho - z_0)t/\Delta}}{z_0 - 1} . \quad (11)$$

Since $z_0 > 1$ for $\rho < 1$ the exponent is negative. This expression is surprisingly accurate for small values of t and ρ although our computing experience indicates that for values of $\rho > 0.90$ the root z_0 must be accurate to twice the number of decimals desired in $w_c(t)$.

One can also expand the denominator of Equation (4) in powers of $\lambda e^{-s\Delta/s} - \lambda$ to get

$$w(t) = (1 - \rho) e^{\lambda t} \sum_{j=0}^{[t/\Delta]} \frac{(j\rho - \lambda t)^j}{j!} e^{-j\rho} \quad (12)$$

where $[x]$ denotes the integral part of x . Write $[t/\Delta] = n$, $(t/\Delta - [t/\Delta]) = \theta < 1$ and $\alpha = \rho e^{-\rho}$. In Equation (12) t is replaced by $n\Delta + \theta$ so that

$$w(t) = w_n(\theta) = (1 - \rho) e^{\rho(n+\theta)} \sum_{j=0}^n \frac{(\alpha(j - n - \theta))^j}{j!} \quad (13)$$

3. A Computing Algorithm

For integer n and $0 \leq \theta < 1$ we observe that both Equation (3) and (13) can be rewritten in the form

$$\begin{aligned} \frac{dw_o}{d\theta} &= \rho w_o(\theta) ; \quad w_o(0^+) = 1 - \rho \\ \frac{dw_n}{d\theta} &= \rho [w_n(\theta) - w_{n-1}(\theta)] \end{aligned} \quad (14)$$

An integrating factor of Equation (14) is $e^{-\rho\theta}$. This can be used to show that the n^{th} derivative of $e^{-\rho\theta} w_n(\theta)$ is

$$\frac{d^n}{d\theta^n} [e^{-\rho\theta} w_n(\theta)] = (1 - \rho) (-\rho)^n \quad (15)$$

and hence that $e^{-\rho\theta} w_n(\theta)$ can be written as an n^{th} order polynomial in θ . In other words, $w_n(\theta)$ is of the form $e^{\rho\theta} [A_n \theta^n + A_{n-1} \theta^{n-1} + \dots + A_0]$ where A_j is independent of θ .

Equation (15) suggests a computing procedure which has been used to calculate $w(t)$. Define polynomials $c_n(k)$ independent of θ such that

$$w_n(\theta) = e^{\rho\theta} \sum_{k=0}^n c_n(k) (\rho\theta)^k. \quad (16)$$

We observe that $w_n(1) = w_{n+1}(0)$ and a binomial expansion of (15) in powers of θ gives

$$\begin{aligned} c_{n+1}^{(k)} &= -\frac{1}{k} c_n^{(k-1)} \\ c_{n+1}^{(0)} &= e^\rho \sum_{k=0}^n c_n^{(k)} \rho^k \end{aligned} \quad (17)$$

subject to the boundary condition $c_0^{(0)} = 1 - \rho$. The procedure of (16) and (17) has the desirable feature that the waiting time distribution for arguments equal to non-integral multiples of the service time can be expressed in terms of the function $w_{n+1}(0) = c_{n+1}^{(0)}$ evaluated at integral multiples of the constant service time.

The tables of the waiting time distribution are organized so that

columns correspond to values of utilization $0.00 \rightarrow 0.99$ (0.01) and rows correspond to values of the argument expressed as a multiple of the constant service time.

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T	PROBABILITY OF WAIT LESS THAN OR EQUAL TO T										
	.00	.01	.02	.03	UTILIZATION		.04	.05	.06	.07	.08
.00	1.0000	.9900	.9800	.9700	.9600	.9500	.9400	.9300	.9200	.9100	
.10		.9910	.9820	.9729	.9638	.9548	.9457	.9365	.9274	.9182	
.20		.9920	.9839	.9758	.9677	.9595	.9513	.9431	.9348	.9265	
.30		.9930	.9859	.9788	.9716	.9644	.9571	.9497	.9423	.9349	
.40		.9940	.9879	.9817	.9755	.9692	.9628	.9564	.9499	.9434	
.50		.9950	.9898	.9847	.9794	.9740	.9686	.9631	.9575	.9519	
.60		.9960	.9918	.9876	.9833	.9789	.9745	.9699	.9652	.9605	
.70		.9970	.9938	.9906	.9873	.9838	.9803	.9767	.9730	.9692	
.80		.9980	.9958	.9936	.9912	.9888	.9862	.9836	.9808	.9779	
.90		.9990	.9978	.9965	.9952	.9937	.9922	.9905	.9887	.9868	
1.00		.9999	.9998	.9995	.9992	.9987	.9981	.9974	.9966	.9957	
1.10			.9998	.9996	.9993	.9989	.9985	.9979	.9972	.9964	
1.20			.9999	.9997	.9995	.9991	.9988	.9983	.9977	.9971	
1.30				.9998	.9996	.9993	.9990	.9987	.9982	.9977	
1.40				.9998	.9997	.9995	.9993	.9990	.9986	.9982	
1.50					.9999	.9998	.9996	.9995	.9993	.9990	.9987
1.60						.9998	.9996	.9995	.9993	.9991	
1.70						.9998	.9998	.9997	.9995	.9994	
1.80							.9999	.9999	.9998	.9997	.9996
1.90								.9999	.9998	.9998	
2.00									.9999	.9999	

T	PROBABILITY OF WAIT LESS THAN OR EQUAL TO T										
	.10	.11	.12	.13	UTILIZATION						.18
	.14	.15	.16	.17	.18	.19					
.00	.9000	.8900	.8800	.8700	.8600	.8500	.8400	.8300	.8200	.8100	
.10	.9090	.8998	.8906	.8814	.8721	.8628	.8535	.8442	.8349	.8255	
.20	.9182	.9098	.9014	.8929	.8844	.8759	.8673	.8587	.8501	.8414	
.30	.9274	.9199	.9123	.9046	.8969	.8891	.8813	.8734	.8655	.8575	
.40	.9367	.9300	.9233	.9164	.9095	.9026	.8955	.8884	.8812	.8740	
.50	.9461	.9403	.9344	.9284	.9224	.9162	.9100	.9036	.8972	.8907	
.60	.9557	.9507	.9457	.9406	.9354	.9300	.9246	.9191	.9135	.9078	
.70	.9653	.9612	.9571	.9529	.9485	.9441	.9396	.9349	.9301	.9252	
.80	.9750	.9719	.9687	.9654	.9619	.9584	.9547	.9509	.9470	.9430	
.90	.9848	.9826	.9804	.9780	.9755	.9729	.9701	.9672	.9642	.9611	
1.00	.9947	.9935	.9922	.9908	.9892	.9876	.9857	.9838	.9817	.9795	
1.10	.9956	.9946	.9935	.9923	.9910	.9895	.9880	.9863	.9845	.9826	
1.20	.9964	.9956	.9947	.9937	.9926	.9914	.9900	.9886	.9871	.9855	
1.30	.9971	.9965	.9957	.9949	.9940	.9930	.9919	.9907	.9895	.9881	
1.40	.9978	.9973	.9967	.9960	.9953	.9945	.9936	.9926	.9916	.9904	
1.50	.9983	.9979	.9975	.9970	.9964	.9958	.9951	.9943	.9934	.9925	
1.60	.9988	.9985	.9982	.9978	.9974	.9969	.9963	.9957	.9950	.9943	
1.70	.9992	.9990	.9987	.9985	.9981	.9978	.9973	.9969	.9964	.9958	
1.80	.9995	.9994	.9992	.9990	.9987	.9985	.9982	.9978	.9974	.9970	
1.90	.9997	.9996	.9995	.9993	.9992	.9990	.9987	.9985	.9982	.9978	
2.00	.9998	.9997	.9996	.9995	.9994	.9992	.9991	.9989	.9986	.9983	
2.10	.9998	.9998	.9997	.9996	.9995	.9994	.9993	.9991	.9989	.9987	
2.20	.9999	.9998	.9998	.9997	.9996	.9995	.9994	.9993	.9991	.9990	
2.30		.9999	.9998	.9998	.9997	.9997	.9996	.9995	.9993	.9992	
2.40			.9999	.9998	.9998	.9997	.9997	.9996	.9995	.9994	
2.50				.9999	.9999	.9998	.9998	.9997	.9996	.9995	
2.60					.9999	.9999	.9998	.9998	.9997	.9996	
2.70						.9999	.9998	.9997	.9997	.9996	
2.80							.9999	.9998	.9998	.9997	
2.90								.9999	.9998	.9998	
3.00									.9999	.9999	

T	PROBABILITY OF WAIT LESS THAN OR EQUAL TO T									
	.60	.61	.62	.63	.64	.65	.66	.67	.68	.69
.00	.4000	.3900	.3800	.3700	.3600	.3500	.3400	.3300	.3200	.3100
.20	.4510	.4406	.4302	.4197	.4092	.3986	.3880	.3773	.3666	.3559
.40	.5085	.4978	.4870	.4760	.4650	.4539	.4427	.4314	.4200	.4085
.60	.5733	.5624	.5512	.5400	.5285	.5169	.5052	.4933	.4812	.4690
.80	.6464	.6353	.6240	.6125	.6007	.5887	.5765	.5640	.5513	.5384
1.00	.7288	.7178	.7064	.6947	.6827	.6704	.6578	.6449	.6316	.6181
1.20	.7677	.7571	.7463	.7351	.7236	.7117	.6994	.6868	.6738	.6604
1.40	.8045	.7947	.7844	.7739	.7629	.7515	.7397	.7275	.7148	.7017
1.60	.8383	.8292	.8197	.8097	.7994	.7886	.7774	.7657	.7535	.7409
1.80	.8676	.8592	.8505	.8413	.8317	.8216	.8110	.7999	.7883	.7762
2.00	.8907	.8832	.8752	.8667	.8578	.8485	.8386	.8282	.8173	.8058
2.20	.9089	.9021	.8949	.8872	.8790	.8704	.8612	.8515	.8413	.8305
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2.60	.9378	.9323	.9265	.9202	.9135	.9063	.8986	.8903	.8815	.8721
2.80	.9486	.9438	.9386	.9329	.9269	.9203	.9133	.9058	.8976	.8889
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3.80	.9800	.9775	.9747	.9717	.9682	.9644	.9602	.9556	.9505	.9449
4.00	.9835	.9813	.9789	.9761	.9731	.9697	.9660	.9618	.9572	.9521
4.20	.9863	.9844	.9823	.9799	.9772	.9743	.9709	.9672	.9630	.9583
4.40	.9887	.9871	.9852	.9831	.9807	.9781	.9751	.9718	.9680	.9638
4.60	.9906	.9892	.9876	.9858	.9837	.9814	.9787	.9757	.9723	.9685
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5.80	.9970	.9964	.9957	.9949	.9940	.9929	.9917	.9902	.9884	.9864
6.00	.9975	.9970	.9964	.9957	.9949	.9940	.9929	.9915	.9900	.9882
6.20	.9979	.9975	.9970	.9964	.9957	.9949	.9939	.9927	.9914	.9898
6.40	.9983	.9979	.9975	.9970	.9964	.9956	.9948	.9937	.9925	.9911
6.60	.9986	.9983	.9979	.9975	.9969	.9963	.9955	.9946	.9935	.9923
6.80	.9988	.9986	.9983	.9979	.9974	.9968	.9962	.9954	.9944	.9933
7.00	.9990	.9988	.9985	.9982	.9978	.9973	.9967	.9960	.9952	.9942
7.20	.9992	.9990	.9988	.9985	.9981	.9977	.9972	.9966	.9958	.9949
7.40	.9993	.9992	.9990	.9987	.9984	.9981	.9976	.9971	.9964	.9956
7.60	.9995	.9993	.9991	.9989	.9987	.9983	.9980	.9975	.9969	.9962
7.80	.9995	.9994	.9993	.9991	.9989	.9986	.9982	.9978	.9973	.9967
8.00	.9996	.9995	.9994	.9992	.9990	.9988	.9985	.9981	.9977	.9971
8.20	.9997	.9996	.9995	.9994	.9992	.9990	.9987	.9984	.9980	.9975
8.40	.9997	.9997	.9996	.9995	.9993	.9991	.9989	.9986	.9983	.9978
8.60	.9998	.9997	.9996	.9995	.9994	.9993	.9991	.9988	.9985	.9981
8.80	.9998	.9998	.9997	.9996	.9995	.9994	.9992	.9990	.9987	.9983
9.00	.9999	.9998	.9998	.9997	.9996	.9995	.9993	.9991	.9989	.9986
9.20		.9998	.9998	.9997	.9996	.9995	.9994	.9992	.9990	.9988
9.40		.9999	.9998	.9998	.9997	.9996	.9995	.9993	.9992	.9989
9.60			.9999	.9998	.9997	.9997	.9996	.9994	.9993	.9991
9.80				.9998	.9998	.9997	.9996	.9995	.9994	.9992
10.00					.9999	.9998	.9998	.9997	.9996	.9995

T	PROBABILITY OF WAIT LESS THAN OR EQUAL TO T									
	.70	.71	.72	.73	.74	.75	.76	.77	.78	.79
.00	.3000	.2900	.2800	.2700	.2600	.2500	.2400	.2300	.2200	.2100
.20	.3451	.3342	.3234	.3124	.3015	.2905	.2794	.2683	.2571	.2459
.40	.3969	.3852	.3735	.3616	.3496	.3375	.3253	.3130	.3006	.2880
.60	.4566	.4440	.4313	.4184	.4053	.3921	.3787	.3651	.3513	.3373
.80	.5252	.5118	.4981	.4842	.4700	.4555	.4408	.4258	.4106	.3951
1.00	.6041	.5899	.5752	.5603	.5449	.5293	.5132	.4967	.4799	.4627
1.20	.6466	.6324	.6178	.6027	.5873	.5713	.5550	.5381	.5208	.5031
1.40	.6882	.6742	.6597	.6447	.6292	.6132	.5966	.5795	.5619	.5437
1.60	.7277	.7140	.6997	.6849	.6696	.6536	.6370	.6198	.6019	.5834
1.80	.7635	.7503	.7364	.7219	.7068	.6910	.6746	.6574	.6395	.6208
2.00	.7937	.7810	.7676	.7536	.7389	.7235	.7073	.6904	.6726	.6540
2.20	.8190	.8070	.7942	.7807	.7666	.7516	.7358	.7192	.7018	.6834
2.40	.8419	.8305	.8183	.8055	.7919	.7775	.7622	.7460	.7289	.7109
2.60	.8620	.8513	.8399	.8277	.8147	.8008	.7861	.7705	.7538	.7362
2.80	.8795	.8695	.8587	.8472	.8349	.8217	.8075	.7925	.7763	.7591
3.00	.8947	.8853	.8752	.8644	.8527	.8402	.8267	.8122	.7966	.7800
3.20	.9080	.8993	.8899	.8797	.8687	.8568	.8439	.8301	.8152	.7991
3.40	.9196	.9116	.9028	.8933	.8830	.8717	.8596	.8463	.8320	.8165
3.60	.9298	.9224	.9142	.9054	.8957	.8851	.8736	.8610	.8474	.8325
3.80	.9387	.9318	.9243	.9161	.9070	.8971	.8862	.8743	.8613	.8470
4.00	.9464	.9401	.9332	.9255	.9171	.9078	.8976	.8863	.8739	.8603
4.20	.9532	.9474	.9410	.9340	.9261	.9174	.9078	.8971	.8854	.8724
4.40	.9591	.9538	.9480	.9414	.9341	.9260	.9170	.9070	.8959	.8835
4.60	.9643	.9595	.9541	.9480	.9413	.9337	.9253	.9159	.9053	.8936
4.80	.9688	.9644	.9595	.9539	.9477	.9406	.9327	.9239	.9140	.9029
5.00	.9727	.9687	.9642	.9591	.9533	.9468	.9395	.9312	.9218	.9113
5.20	.9762	.9726	.9684	.9637	.9584	.9524	.9455	.9377	.9289	.9190
5.40	.9792	.9759	.9721	.9678	.9629	.9573	.9509	.9437	.9354	.9260
5.60	.9818	.9788	.9754	.9715	.9670	.9618	.9558	.9491	.9413	.9325
5.80	.9841	.9814	.9783	.9747	.9705	.9658	.9602	.9539	.9467	.9383
6.00	.9861	.9837	.9808	.9776	.9737	.9693	.9642	.9583	.9515	.9437
6.20	.9879	.9857	.9831	.9801	.9766	.9725	.9678	.9623	.9559	.9486
6.40	.9894	.9874	.9851	.9823	.9791	.9754	.9710	.9659	.9600	.9530
6.60	.9907	.9890	.9868	.9843	.9814	.9779	.9739	.9692	.9636	.9571
6.80	.9919	.9903	.9884	.9861	.9834	.9802	.9765	.9721	.9669	.9608
7.00	.9929	.9915	.9897	.9877	.9852	.9823	.9788	.9748	.9699	.9642
7.20	.9938	.9925	.9909	.9891	.9868	.9841	.9810	.9772	.9727	.9674
7.40	.9946	.9934	.9920	.9903	.9883	.9858	.9829	.9794	.9752	.9702
7.60	.9953	.9942	.9929	.9914	.9895	.9873	.9846	.9813	.9774	.9728
7.80	.9959	.9949	.9938	.9924	.9907	.9886	.9861	.9831	.9795	.9751
8.00	.9964	.9956	.9945	.9932	.9917	.9898	.9875	.9847	.9814	.9773
8.20	.9969	.9961	.9952	.9940	.9926	.9909	.9887	.9862	.9831	.9793
8.40	.9973	.9966	.9957	.9947	.9934	.9918	.9899	.9875	.9846	.9811
8.60	.9976	.9970	.9962	.9953	.9941	.9927	.9909	.9887	.9860	.9827
8.80	.9979	.9974	.9967	.9958	.9947	.9934	.9918	.9898	.9873	.9842
9.00	.9982	.9977	.9971	.9963	.9953	.9941	.9926	.9907	.9884	.9856
9.20	.9984	.9980	.9974	.9967	.9958	.9947	.9933	.9916	.9895	.9868
9.40	.9986	.9982	.9977	.9971	.9963	.9953	.9940	.9924	.9905	.9880
9.60	.9988	.9984	.9980	.9974	.9967	.9958	.9946	.9932	.9913	.9890
9.80	.9989	.9986	.9982	.9977	.9970	.9962	.9951	.9938	.9921	.9900

T	PROBABILITY OF WAIT LESS THAN OR EQUAL TO T									
	UTILIZATION									
	.70	.71	.72	.73	.74	.75	.76	.77	.78	.79
10.00	.9991	.9988	.9984	.9980	.9974	.9966	.9956	.9944	.9928	.9908
10.20	.9992	.9989	.9986	.9982	.9977	.9970	.9961	.9949	.9935	.9916
10.40	.9993	.9991	.9988	.9984	.9979	.9973	.9965	.9954	.9941	.9924
10.60	.9994	.9992	.9989	.9986	.9981	.9976	.9968	.9959	.9946	.9930
10.80	.9995	.9993	.9990	.9987	.9983	.9978	.9971	.9963	.9951	.9936
11.00	.9995	.9994	.9992	.9989	.9985	.9980	.9974	.9966	.9956	.9942
11.20	.9996	.9994	.9993	.9990	.9987	.9982	.9977	.9969	.9960	.9947
11.40	.9996	.9995	.9993	.9991	.9988	.9984	.9979	.9972	.9963	.9952
11.60	.9997	.9996	.9994	.9992	.9989	.9986	.9981	.9975	.9967	.9956
11.80	.9997	.9996	.9995	.9993	.9991	.9987	.9983	.9977	.9970	.9960
12.00	.9998	.9997	.9995	.9994	.9992	.9989	.9985	.9979	.9972	.9963
12.20	.9998	.9997	.9996	.9995	.9993	.9990	.9986	.9981	.9975	.9966
12.40	.9998	.9997	.9996	.9995	.9993	.9991	.9988	.9983	.9977	.9969
12.60	.9998	.9998	.9997	.9996	.9994	.9992	.9989	.9985	.9979	.9972
12.80	.9999	.9998	.9997	.9996	.9995	.9993	.9990	.9986	.9981	.9974
13.00	.9998	.9998	.9997	.9995	.9993	.9991	.9988	.9983	.9977	
13.20	.9998	.9998	.9997	.9996	.9994	.9992	.9989	.9984	.9979	
13.40	.9999	.9998	.9997	.9996	.9995	.9993	.9990	.9986	.9980	
13.60	.9999	.9998	.9998	.9997	.9995	.9993	.9991	.9987	.9982	
13.80	.9999	.9999	.9998	.9997	.9996	.9994	.9992	.9988	.9984	
14.00		.9998	.9997	.9996	.9995	.9992	.9989	.9985	.9985	
14.20		.9998	.9998	.9997	.9995	.9993	.9990	.9986	.9986	
14.40		.9999	.9998	.9998	.9997	.9996	.9994	.9991	.9988	
14.60		.9999	.9998	.9998	.9997	.9996	.9994	.9992	.9989	
14.80		.9999	.9998	.9998	.9997	.9995	.9993	.9993	.9990	
15.00			.9999	.9998	.9997	.9995	.9993	.9991	.9991	
15.20			.9998	.9997	.9996	.9994	.9992	.9990	.9990	
15.40			.9998	.9997	.9996	.9994	.9992	.9990	.9991	
15.60			.9998	.9998	.9997	.9996	.9994	.9992	.9992	
15.80			.9999	.9998	.9998	.9997	.9995	.9995	.9993	
16.00				.9998	.9997	.9996	.9994	.9993	.9994	
16.20				.9998	.9998	.9996	.9994	.9995	.9995	
16.40				.9998	.9998	.9998	.9997	.9995	.9995	
16.60				.9999	.9998	.9998	.9997	.9997	.9995	
16.80				.9999	.9998	.9998	.9998	.9997	.9996	
17.00					.9998	.9997	.9996	.9994	.9996	
17.20					.9998	.9998	.9996	.9998	.9997	
17.40					.9999	.9998	.9998	.9998	.9997	
17.60					.9999	.9999	.9998	.9998	.9997	
17.80					.9999	.9999	.9998	.9998	.9997	
18.00						.9998	.9998	.9998	.9998	
18.20						.9999	.9999	.9998	.9998	
18.40						.9999	.9999	.9999	.9998	
18.60						.9999	.9999	.9999	.9998	
18.80						.9999	.9999	.9999	.9998	
19.00							.9998	.9998	.9998	
19.20							.9999	.9999	.9999	
19.40							.9999	.9999	.9999	
19.60							.9999	.9999	.9999	
19.80							.9999	.9999	.9999	
20.00								.9999	.9999	

T	PROBABILITY OF WAIT LESS THAN OR EQUAL TO T									
	.80	.81	.82	.83	UTILIZATION					.89
	.84	.85	.86	.87	.88					
.00	.2000	.1900	.1800	.1700	.1600	.1500	.1400	.1300	.1200	.1100
.20	.2347	.2234	.2121	.2007	.1893	.1778	.1663	.1547	.1431	.1314
.40	.2754	.2627	.2499	.2369	.2239	.2107	.1975	.1841	.1706	.1570
.60	.3232	.3089	.2944	.2797	.2649	.2498	.2345	.2191	.2035	.1876
.80	.3793	.3632	.3469	.3302	.3133	.2961	.2786	.2607	.2426	.2242
1.00	.4451	.4271	.4087	.3899	.3706	.3509	.3308	.3103	.2893	.2679
1.20	.4848	.4660	.4467	.4269	.4066	.3858	.3643	.3424	.3198	.2967
1.40	.5248	.5054	.4854	.4647	.4434	.4214	.3987	.3754	.3513	.3265
1.60	.5642	.5443	.5236	.5022	.4800	.4570	.4332	.4086	.3831	.3567
1.80	.6014	.5811	.5600	.5381	.5152	.4914	.4666	.4409	.4141	.3863
2.00	.6345	.6141	.5928	.5705	.5472	.5228	.4973	.4707	.4429	.4139
2.20	.6640	.6437	.6223	.5999	.5763	.5515	.5255	.4982	.4696	.4396
2.40	.6918	.6716	.6503	.6278	.6041	.5790	.5526	.5248	.4955	.4647
2.60	.7174	.6975	.6763	.6539	.6302	.6050	.5784	.5502	.5203	.4887
2.80	.7408	.7212	.7004	.6781	.6545	.6293	.6025	.5741	.5438	.5117
3.00	.7621	.7430	.7225	.7005	.6771	.6520	.6252	.5966	.5660	.5334
3.20	.7817	.7631	.7430	.7214	.6982	.6733	.6466	.6179	.5872	.5543
3.40	.7998	.7816	.7620	.7409	.7180	.6934	.6668	.6382	.6074	.5742
3.60	.8163	.7987	.7797	.7590	.7365	.7122	.6859	.6574	.6266	.5933
3.80	.8315	.8145	.7960	.7758	.7538	.7299	.7039	.6756	.6448	.6114
4.00	.8454	.8290	.8111	.7914	.7699	.7465	.7208	.6928	.6622	.6288
4.20	.8581	.8424	.8251	.8060	.7850	.7620	.7368	.7090	.6787	.6454
4.40	.8699	.8547	.8380	.8195	.7991	.7766	.7518	.7245	.6944	.6613
4.60	.8806	.8661	.8500	.8321	.8123	.7903	.7660	.7391	.7093	.6764
4.80	.8905	.8766	.8611	.8439	.8246	.8032	.7794	.7529	.7235	.6909
5.00	.8995	.8863	.8714	.8547	.8361	.8153	.7920	.7660	.7370	.7047
5.20	.9078	.8952	.8809	.8649	.8469	.8266	.8039	.7784	.7499	.7179
5.40	.9154	.9034	.8897	.8743	.8569	.8373	.8151	.7902	.7621	.7305
5.60	.9224	.9109	.8979	.8831	.8663	.8472	.8257	.8013	.7737	.7426
5.80	.9288	.9179	.9055	.8913	.8751	.8566	.8356	.8118	.7848	.7541
6.00	.9347	.9243	.9125	.8988	.8833	.8654	.8450	.8218	.7953	.7651
6.20	.9401	.9303	.9189	.9059	.8909	.8737	.8539	.8312	.8053	.7756
6.40	.9450	.9357	.9249	.9125	.8981	.8814	.8623	.8402	.8148	.7856
6.60	.9496	.9407	.9305	.9186	.9047	.8887	.8701	.8487	.8238	.7952
6.80	.9537	.9454	.9356	.9243	.9110	.8955	.8776	.8567	.8324	.8044
7.00	.9575	.9497	.9404	.9295	.9168	.9020	.8846	.8643	.8406	.8131
7.20	.9611	.9536	.9448	.9345	.9223	.9080	.8912	.8715	.8484	.8215
7.40	.9643	.9572	.9489	.9390	.9274	.9136	.8974	.8783	.8558	.8294
7.60	.9672	.9606	.9527	.9433	.9321	.9189	.9033	.8847	.8629	.8371
7.80	.9699	.9637	.9562	.9473	.9366	.9239	.9088	.8909	.8696	.8444
8.00	.9724	.9665	.9594	.9509	.9408	.9286	.9140	.8966	.8759	.8513
8.20	.9747	.9691	.9624	.9544	.9446	.9330	.9189	.9021	.8820	.8580
8.40	.9768	.9716	.9652	.9575	.9483	.9371	.9236	.9073	.8878	.8643
8.60	.9787	.9738	.9678	.9605	.9517	.9409	.9279	.9122	.8932	.8704
8.80	.9805	.9758	.9702	.9633	.9548	.9446	.9321	.9169	.8985	.8762
9.00	.9821	.9777	.9724	.9658	.9578	.9480	.9359	.9213	.9034	.8817
9.20	.9835	.9795	.9744	.9682	.9606	.9512	.9396	.9255	.9081	.8870
9.40	.9849	.9811	.9763	.9704	.9631	.9541	.9431	.9294	.9126	.8920
9.60	.9862	.9826	.9781	.9725	.9656	.9570	.9463	.9331	.9169	.8969
9.80	.9873	.9839	.9797	.9744	.9678	.9596	.9494	.9367	.9210	.9015

T	PROBABILITY OF WAIT LESS THAN OR EQUAL TO T											
	.80	.81	.82	.83	UTILIZATION		.84	.85	.86	.87	.88	.89
20.00	.9998	.9997	.9996	.9994	.9990	.9984	.9975	.9961	.9939	.9904		
20.20	.9999	.9998	.9996	.9994	.9991	.9985	.9976	.9963	.9942	.9909		
20.40	.9999	.9998	.9997	.9994	.9991	.9986	.9978	.9965	.9944	.9913		
20.60	.9999	.9998	.9997	.9995	.9992	.9987	.9979	.9967	.9947	.9917		
20.80	.9999	.9998	.9997	.9995	.9992	.9988	.9980	.9968	.9950	.9920		
21.00		.9998	.9997	.9996	.9993	.9988	.9981	.9970	.9952	.9924		
21.20		.9998	.9997	.9996	.9993	.9989	.9982	.9972	.9955	.9927		
21.40		.9999	.9998	.9996	.9994	.9990	.9983	.9973	.9957	.9931		
21.60		.9999	.9998	.9996	.9994	.9990	.9984	.9975	.9959	.9934		
21.80		.9999	.9998	.9997	.9995	.9991	.9985	.9976	.9961	.9937		
22.00			.9998	.9997	.9995	.9992	.9986	.9977	.9963	.9940		
22.20			.9998	.9997	.9995	.9992	.9987	.9978	.9965	.9942		
22.40			.9998	.9997	.9996	.9993	.9988	.9980	.9966	.9945		
22.60			.9999	.9998	.9996	.9993	.9988	.9981	.9968	.9947		
22.80			.9999	.9998	.9996	.9993	.9989	.9982	.9970	.9950		
23.00			.9999	.9998	.9996	.9994	.9990	.9983	.9971	.9952		
23.20			.9999	.9998	.9997	.9994	.9990	.9984	.9972	.9954		
23.40			.9999	.9998	.9997	.9995	.9991	.9984	.9974	.9956		
23.60			.9999	.9998	.9997	.9995	.9991	.9985	.9975	.9958		
23.80			.9999	.9998	.9997	.9995	.9992	.9986	.9976	.9960		
24.00				.9998	.9997	.9995	.9992	.9987	.9977	.9962		
24.20				.9999	.9998	.9996	.9993	.9987	.9979	.9963		
24.40				.9999	.9998	.9996	.9993	.9988	.9980	.9965		
24.60				.9999	.9998	.9996	.9994	.9989	.9981	.9967		
24.80				.9999	.9998	.9997	.9994	.9989	.9982	.9968		
25.00					.9998	.9997	.9994	.9990	.9982	.9970		
25.20					.9998	.9997	.9995	.9990	.9983	.9971		
25.40					.9998	.9997	.9995	.9991	.9984	.9972		
25.60					.9998	.9997	.9995	.9991	.9985	.9973		
25.80					.9999	.9997	.9995	.9992	.9986	.9975		
26.00					.9999	.9998	.9996	.9992	.9986	.9976		
26.20					.9999	.9998	.9996	.9993	.9987	.9977		
26.40					.9999	.9998	.9996	.9993	.9988	.9978		
26.60					.9999	.9998	.9996	.9993	.9988	.9979		
26.80					.9999	.9998	.9997	.9994	.9989	.9980		
27.00						.9998	.9997	.9994	.9989	.9981		
27.20						.9998	.9997	.9994	.9990	.9982		
27.40						.9998	.9997	.9995	.9990	.9982		
27.60						.9999	.9997	.9995	.9991	.9983		
27.80						.9999	.9997	.9995	.9991	.9984		
28.00						.9999	.9998	.9996	.9992	.9985		
28.20						.9999	.9998	.9996	.9992	.9985		
28.40						.9999	.9998	.9996	.9993	.9986		
28.60						.9999	.9998	.9996	.9993	.9987		
28.80						.9999	.9998	.9996	.9993	.9987		
29.00							.9998	.9997	.9994	.9988		
29.20							.9998	.9997	.9994	.9988		
29.40							.9998	.9997	.9994	.9989		
29.60							.9999	.9997	.9994	.9989		
29.80							.9999	.9997	.9995	.9990		
30.00							.9999	.9997	.9995	.9990		

T	PROBABILITY OF WAIT LESS THAN OR EQUAL TO T										
						UTILIZATION					
	.80	.81	.82	.83	.84	.85	.86	.87	.88	.89	
10.00	.9883	.9852	.9812	.9762	.9699	.9621	.9523	.9400	.9248	.9059	
10.20	.9893	.9863	.9826	.9779	.9719	.9644	.9550	.9432	.9285	.9101	
10.40	.9902	.9874	.9839	.9794	.9737	.9666	.9576	.9462	.9320	.9141	
10.60	.9910	.9884	.9851	.9808	.9755	.9686	.9600	.9491	.9353	.9180	
10.80	.9917	.9893	.9862	.9822	.9771	.9706	.9623	.9518	.9385	.9216	
11.00	.9924	.9901	.9872	.9834	.9786	.9724	.9644	.9543	.9415	.9251	
11.20	.9930	.9909	.9882	.9846	.9800	.9741	.9665	.9568	.9443	.9285	
11.40	.9936	.9916	.9890	.9857	.9813	.9757	.9684	.9591	.9471	.9317	
11.60	.9941	.9923	.9898	.9867	.9825	.9772	.9702	.9612	.9496	.9347	
11.80	.9946	.9929	.9906	.9876	.9837	.9786	.9719	.9633	.9521	.9376	
12.00	.9951	.9934	.9913	.9885	.9847	.9799	.9735	.9652	.9544	.9404	
12.20	.9955	.9940	.9919	.9893	.9857	.9811	.9750	.9671	.9567	.9431	
12.40	.9959	.9944	.9925	.9900	.9867	.9823	.9765	.9688	.9588	.9456	
12.60	.9962	.9949	.9931	.9907	.9875	.9834	.9778	.9705	.9608	.9481	
12.80	.9965	.9953	.9936	.9914	.9884	.9844	.9791	.9720	.9627	.9504	
13.00	.9968	.9956	.9941	.9920	.9891	.9853	.9803	.9735	.9645	.9526	
13.20	.9971	.9960	.9945	.9925	.9898	.9862	.9814	.9749	.9663	.9547	
13.40	.9973	.9963	.9949	.9930	.9905	.9871	.9825	.9763	.9679	.9568	
13.60	.9975	.9966	.9953	.9935	.9911	.9879	.9835	.9775	.9695	.9587	
13.80	.9977	.9969	.9956	.9940	.9917	.9886	.9844	.9787	.9710	.9605	
14.00	.9979	.9971	.9960	.9944	.9923	.9893	.9853	.9798	.9724	.9623	
14.20	.9981	.9973	.9963	.9948	.9928	.9900	.9861	.9809	.9737	.9640	
14.40	.9982	.9975	.9965	.9952	.9932	.9906	.9869	.9819	.9750	.9656	
14.60	.9984	.9977	.9968	.9955	.9937	.9912	.9877	.9829	.9762	.9671	
14.80	.9985	.9979	.9970	.9958	.9941	.9917	.9884	.9838	.9774	.9686	
15.00	.9986	.9981	.9973	.9961	.9945	.9922	.9891	.9846	.9785	.9700	
15.20	.9988	.9982	.9975	.9964	.9948	.9927	.9897	.9855	.9796	.9714	
15.40	.9989	.9984	.9976	.9966	.9952	.9931	.9903	.9862	.9806	.9726	
15.60	.9990	.9985	.9978	.9969	.9955	.9936	.9908	.9870	.9815	.9739	
15.80	.9990	.9986	.9980	.9971	.9958	.9940	.9913	.9876	.9824	.9750	
16.00	.9991	.9987	.9981	.9973	.9961	.9943	.9918	.9883	.9833	.9761	
16.20	.9992	.9988	.9983	.9975	.9963	.9947	.9923	.9889	.9841	.9772	
16.40	.9993	.9989	.9984	.9977	.9966	.9950	.9927	.9895	.9849	.9782	
16.60	.9993	.9990	.9985	.9978	.9968	.9953	.9932	.9901	.9856	.9792	
16.80	.9994	.9991	.9986	.9980	.9970	.9956	.9936	.9906	.9863	.9801	
17.00	.9994	.9991	.9987	.9981	.9972	.9959	.9939	.9911	.9870	.9810	
17.20	.9995	.9992	.9988	.9982	.9974	.9961	.9943	.9916	.9876	.9819	
17.40	.9995	.9993	.9989	.9984	.9976	.9964	.9946	.9920	.9882	.9827	
17.60	.9996	.9993	.9990	.9985	.9977	.9966	.9949	.9924	.9888	.9835	
17.80	.9996	.9994	.9991	.9986	.9979	.9968	.9952	.9928	.9893	.9842	
18.00	.9996	.9994	.9991	.9987	.9980	.9970	.9955	.9932	.9899	.9849	
18.20	.9997	.9995	.9992	.9988	.9981	.9972	.9957	.9936	.9904	.9856	
18.40	.9997	.9995	.9993	.9989	.9983	.9973	.9960	.9939	.9908	.9862	
18.60	.9997	.9996	.9993	.9989	.9984	.9975	.9962	.9942	.9913	.9868	
18.80	.9997	.9996	.9994	.9990	.9985	.9977	.9964	.9945	.9917	.9874	
19.00	.9998	.9996	.9994	.9991	.9986	.9978	.9966	.9948	.9921	.9880	
19.20	.9998	.9997	.9995	.9991	.9987	.9979	.9968	.9951	.9925	.9885	
19.40	.9998	.9997	.9995	.9992	.9988	.9981	.9970	.9954	.9929	.9890	
19.60	.9998	.9997	.9995	.9993	.9988	.9982	.9972	.9956	.9932	.9895	
19.80	.9998	.9997	.9996	.9993	.9989	.9983	.9973	.9958	.9935	.9900	

T	PROBABILITY OF WAIT LESS THAN OR EQUAL TO T									
	.90	.91	.92	.93	UTILIZATION		.96	.97	.98	.99
					.94	.95				
.00	.1000	.0900	.0800	.0700	.0600	.0500	.0400	.0300	.0200	.0100
.20	.1197	.1080	.0962	.0843	.0724	.0605	.0485	.0364	.0243	.0122
.40	.1433	.1295	.1156	.1015	.0874	.0731	.0587	.0442	.0296	.0149
.60	.1716	.1554	.1389	.1223	.1055	.0884	.0712	.0537	.0360	.0181
.80	.2054	.1864	.1670	.1473	.1273	.1069	.0862	.0652	.0438	.0221
1.00	.2460	.2236	.2007	.1774	.1536	.1293	.1045	.0791	.0533	.0269
1.20	.2729	.2486	.2236	.1980	.1718	.1449	.1173	.0890	.0601	.0304
1.40	.3009	.2746	.2475	.2196	.1909	.1613	.1308	.0995	.0673	.0341
1.60	.3294	.3012	.2719	.2417	.2105	.1782	.1449	.1104	.0748	.0380
1.80	.3574	.3274	.2961	.2637	.2301	.1952	.1590	.1214	.0824	.0419
2.00	.3836	.3520	.3190	.2847	.2488	.2115	.1725	.1320	.0898	.0458
2.20	.4082	.3752	.3407	.3046	.2667	.2271	.1857	.1423	.0970	.0496
2.40	.4322	.3980	.3621	.3242	.2845	.2427	.1988	.1526	.1042	.0534
2.60	.4554	.4201	.3828	.3434	.3019	.2580	.2117	.1629	.1114	.0572
2.80	.4775	.4413	.4028	.3620	.3188	.2730	.2244	.1730	.1186	.0609
3.00	.4987	.4616	.4221	.3800	.3352	.2876	.2369	.1829	.1256	.0647
3.20	.5190	.4812	.4408	.3975	.3513	.3019	.2491	.1928	.1326	.0684
3.40	.5385	.5001	.4589	.4146	.3670	.3160	.2612	.2025	.1396	.0722
3.60	.5573	.5184	.4764	.4312	.3824	.3298	.2731	.2121	.1465	.0759
3.80	.5752	.5359	.4934	.4472	.3973	.3433	.2848	.2216	.1533	.0796
4.00	.5925	.5529	.5098	.4629	.4119	.3565	.2963	.2310	.1601	.0833
4.20	.6090	.5692	.5256	.4781	.4261	.3694	.3076	.2403	.1669	.0870
4.40	.6249	.5849	.5410	.4928	.4400	.3821	.3188	.2494	.1735	.0906
4.60	.6401	.6000	.5558	.5072	.4536	.3946	.3297	.2585	.1802	.0943
4.80	.6547	.6146	.5702	.5211	.4668	.4068	.3405	.2674	.1868	.0979
5.00	.6687	.6287	.5841	.5346	.4797	.4187	.3511	.2762	.1933	.1015
5.20	.6822	.6422	.5976	.5478	.4923	.4304	.3616	.2849	.1997	.1051
5.40	.6951	.6552	.6106	.5606	.5046	.4419	.3718	.2936	.2062	.1087
5.60	.7074	.6678	.6232	.5730	.5166	.4531	.3819	.3021	.2125	.1122
5.80	.7193	.6799	.6354	.5851	.5283	.4642	.3919	.3105	.2189	.1158
6.00	.7307	.6916	.6472	.5968	.5397	.4749	.4017	.3188	.2251	.1193
6.20	.7416	.7029	.6586	.6082	.5508	.4855	.4113	.3270	.2313	.1229
6.40	.7521	.7137	.6697	.6193	.5617	.4959	.4208	.3351	.2375	.1264
6.60	.7622	.7241	.6804	.6301	.5723	.5060	.4301	.3431	.2436	.1299
6.80	.7718	.7342	.6907	.6405	.5827	.5160	.4393	.3510	.2497	.1334
7.00	.7811	.7439	.7007	.6507	.5928	.5257	.4483	.3588	.2557	.1368
7.20	.7900	.7532	.7104	.6606	.6026	.5353	.4571	.3666	.2617	.1403
7.40	.7985	.7622	.7198	.6702	.6122	.5446	.4659	.3742	.2676	.1437
7.60	.8067	.7709	.7289	.6795	.6216	.5538	.4745	.3817	.2735	.1472
7.80	.8145	.7793	.7376	.6886	.6308	.5628	.4829	.3892	.2793	.1506
8.00	.8220	.7873	.7461	.6974	.6397	.5716	.4913	.3966	.2851	.1540
8.20	.8293	.7951	.7543	.7059	.6484	.5802	.4994	.4038	.2908	.1574
8.40	.8362	.8025	.7623	.7142	.6569	.5887	.5075	.4110	.2965	.1608
8.60	.8428	.8097	.7700	.7223	.6652	.5970	.5154	.4181	.3021	.1641
8.80	.8492	.8167	.7774	.7302	.6733	.6051	.5232	.4251	.3077	.1675
9.00	.8553	.8234	.7846	.7378	.6812	.6130	.5309	.4320	.3133	.1708
9.20	.8612	.8298	.7916	.7452	.6890	.6208	.5384	.4389	.3188	.1741
9.40	.8668	.8360	.7983	.7524	.6965	.6285	.5459	.4456	.3243	.1774
9.60	.8722	.8420	.8049	.7594	.7038	.6359	.5532	.4523	.3297	.1807
9.80	.8774	.8477	.8112	.7662	.7110	.6433	.5603	.4589	.3351	.1840

T	PROBABILITY OF WAIT LESS THAN OR EQUAL TO T									
	.90	.91	.92	.93	.94	.95	.96	.97	.98	.99
10.00	.8824	.8533	.8173	.7728	.7180	.6505	.5674	.4654	.3404	.1873
10.20	.8872	.8587	.8232	.7793	.7248	.6575	.5744	.4719	.3457	.1905
10.40	.8918	.8638	.8289	.7855	.7315	.6644	.5812	.4783	.3509	.1938
10.60	.8961	.8688	.8345	.7916	.7380	.6712	.5880	.4845	.3561	.1970
10.80	.9004	.8736	.8398	.7975	.7443	.6778	.5946	.4907	.3613	.2002
11.00	.9044	.8782	.8450	.8032	.7505	.6843	.6011	.4969	.3664	.2034
11.20	.9083	.8826	.8500	.8088	.7565	.6906	.6075	.5029	.3715	.2066
11.40	.9120	.8869	.8549	.8142	.7624	.6969	.6138	.5089	.3766	.2098
11.60	.9156	.8910	.8596	.8194	.7682	.7030	.6201	.5149	.3816	.2130
11.80	.9190	.8950	.8641	.8245	.7738	.7089	.6262	.5207	.3865	.2161
12.00	.9223	.8988	.8685	.8295	.7793	.7148	.6322	.5265	.3914	.2192
12.20	.9254	.9025	.8728	.8343	.7846	.7206	.6381	.5322	.3963	.2224
12.40	.9285	.9061	.8769	.8390	.7898	.7262	.6439	.5378	.4012	.2255
12.60	.9314	.9095	.8809	.8435	.7949	.7317	.6497	.5434	.4060	.2286
12.80	.9342	.9128	.8847	.8480	.7999	.7371	.6553	.5489	.4107	.2317
13.00	.9368	.9160	.8885	.8523	.8047	.7424	.6608	.5543	.4155	.2348
13.20	.9394	.9190	.8921	.8564	.8094	.7476	.6663	.5597	.4202	.2378
13.40	.9419	.9220	.8956	.8605	.8141	.7527	.6717	.5650	.4248	.2409
13.60	.9442	.9248	.8990	.8644	.8186	.7576	.6769	.5702	.4294	.2439
13.80	.9465	.9276	.9022	.8683	.8230	.7625	.6821	.5754	.4340	.2469
14.00	.9486	.9302	.9054	.8720	.8272	.7673	.6873	.5805	.4385	.2500
14.20	.9507	.9328	.9084	.8756	.8314	.7720	.6923	.5856	.4430	.2530
14.40	.9527	.9352	.9114	.8791	.8355	.7766	.6972	.5906	.4475	.2560
14.60	.9547	.9376	.9143	.8826	.8395	.7811	.7021	.5955	.4519	.2589
14.80	.9565	.9399	.9171	.8859	.8434	.7855	.7069	.6004	.4563	.2619
15.00	.9583	.9420	.9197	.8891	.8472	.7898	.7116	.6052	.4607	.2649
15.20	.9600	.9442	.9223	.8922	.8509	.7940	.7163	.6100	.4650	.2678
15.40	.9616	.9462	.9248	.8953	.8545	.7982	.7208	.6147	.4693	.2707
15.60	.9631	.9482	.9273	.8983	.8580	.8023	.7253	.6193	.4736	.2737
15.80	.9646	.9500	.9296	.9011	.8614	.8062	.7297	.6239	.4778	.2766
16.00	.9661	.9519	.9319	.9039	.8648	.8101	.7341	.6284	.4820	.2795
16.20	.9674	.9536	.9341	.9066	.8681	.8140	.7384	.6329	.4861	.2824
16.40	.9688	.9553	.9362	.9093	.8712	.8177	.7426	.6373	.4903	.2852
16.60	.9700	.9569	.9383	.9118	.8744	.8214	.7467	.6417	.4943	.2881
16.80	.9712	.9585	.9403	.9143	.8774	.8250	.7508	.6460	.4984	.2909
17.00	.9724	.9600	.9422	.9168	.8804	.8285	.7548	.6503	.5024	.2938
17.20	.9735	.9615	.9441	.9191	.8833	.8320	.7587	.6545	.5064	.2966
17.40	.9746	.9629	.9459	.9214	.8861	.8353	.7626	.6587	.5104	.2994
17.60	.9756	.9642	.9477	.9236	.8888	.8387	.7664	.6628	.5143	.3022
17.80	.9766	.9655	.9494	.9258	.8915	.8419	.7702	.6668	.5182	.3050
18.00	.9776	.9668	.9510	.9279	.8942	.8451	.7739	.6708	.5221	.3078
18.20	.9785	.9680	.9526	.9299	.8967	.8482	.7775	.6748	.5259	.3106
18.40	.9794	.9692	.9541	.9319	.8992	.8513	.7811	.6787	.5297	.3133
18.60	.9802	.9703	.9556	.9338	.9017	.8543	.7846	.6826	.5335	.3161
18.80	.9810	.9714	.9570	.9357	.9040	.8572	.7881	.6864	.5372	.3188
19.00	.9818	.9724	.9584	.9375	.9064	.8601	.7915	.6902	.5409	.3216
19.20	.9825	.9734	.9598	.9393	.9086	.8629	.7949	.6939	.5446	.3243
19.40	.9832	.9744	.9611	.9410	.9108	.8657	.7982	.6976	.5483	.3270
19.60	.9839	.9753	.9623	.9427	.9130	.8684	.8014	.7013	.5519	.3297
19.80	.9846	.9762	.9636	.9443	.9151	.8710	.8046	.7049	.5555	.3324

T	PROBABILITY OF WAIT LESS THAN OR EQUAL TO T															
	.90		.91		.92		.93		UTILIZATION		.94	.95	.96	.97	.98	.99
20.00	.9852	.9771	.9647	.9459	.9172	.8736	.8077	.7084	.5591	.3350						
20.20	.9858	.9779	.9659	.9474	.9192	.8762	.8108	.7119	.5626	.3377						
20.40	.9864	.9787	.9670	.9489	.9211	.8787	.8139	.7154	.5661	.3404						
20.60	.9869	.9795	.9681	.9503	.9230	.8811	.8169	.7188	.5696	.3430						
20.80	.9874	.9803	.9691	.9517	.9249	.8835	.8198	.7222	.5730	.3456						
21.00	.9880	.9810	.9701	.9531	.9267	.8858	.8227	.7256	.5765	.3483						
21.20	.9884	.9817	.9711	.9544	.9285	.8881	.8256	.7289	.5799	.3509						
21.40	.9889	.9823	.9720	.9557	.9302	.8904	.8284	.7321	.5832	.3535						
21.60	.9894	.9830	.9729	.9570	.9319	.8926	.8311	.7354	.5866	.3561						
21.80	.9898	.9836	.9738	.9582	.9336	.8948	.8339	.7386	.5899	.3586						
22.00	.9902	.9842	.9746	.9594	.9352	.8969	.8365	.7417	.5932	.3612						
22.20	.9906	.9848	.9754	.9605	.9367	.8990	.8392	.7448	.5964	.3638						
22.40	.9910	.9853	.9762	.9616	.9383	.9010	.8418	.7479	.5997	.3663						
22.60	.9914	.9859	.9770	.9627	.9398	.9030	.8443	.7509	.6029	.3688						
22.80	.9917	.9864	.9778	.9638	.9412	.9049	.8468	.7539	.6061	.3714						
23.00	.9920	.9869	.9785	.9648	.9426	.9069	.8493	.7569	.6092	.3739						
23.20	.9924	.9874	.9792	.9658	.9440	.9087	.8517	.7598	.6124	.3764						
23.40	.9927	.9878	.9798	.9668	.9454	.9106	.8541	.7627	.6155	.3789						
23.60	.9930	.9883	.9805	.9677	.9467	.9124	.8564	.7656	.6186	.3814						
23.80	.9933	.9887	.9811	.9686	.9480	.9141	.8587	.7684	.6216	.3839						
24.00	.9935	.9891	.9817	.9695	.9492	.9159	.8610	.7712	.6247	.3863						
24.20	.9938	.9895	.9823	.9704	.9505	.9176	.8632	.7740	.6277	.3888						
24.40	.9940	.9899	.9829	.9712	.9517	.9192	.8654	.7767	.6307	.3912						
24.60	.9943	.9903	.9835	.9720	.9528	.9208	.8676	.7794	.6336	.3937						
24.80	.9945	.9906	.9840	.9728	.9540	.9224	.8697	.7820	.6366	.3961						
25.00	.9947	.9910	.9845	.9736	.9551	.9240	.8718	.7847	.6395	.3985						
25.20	.9950	.9913	.9850	.9743	.9562	.9255	.8739	.7872	.6424	.4009						
25.40	.9952	.9916	.9855	.9750	.9572	.9270	.8759	.7898	.6452	.4033						
25.60	.9954	.9919	.9860	.9758	.9583	.9285	.8779	.7923	.6481	.4057						
25.80	.9955	.9922	.9864	.9764	.9593	.9299	.8799	.7948	.6509	.4081						
26.00	.9957	.9925	.9869	.9771	.9603	.9314	.8818	.7973	.6537	.4105						
26.20	.9959	.9928	.9873	.9778	.9612	.9327	.8837	.7998	.6565	.4128						
26.40	.9961	.9930	.9877	.9784	.9622	.9341	.8856	.8022	.6592	.4152						
26.60	.9962	.9933	.9881	.9790	.9631	.9354	.8874	.8046	.6620	.4175						
26.80	.9964	.9935	.9885	.9796	.9640	.9367	.8892	.8069	.6647	.4199						
27.00	.9965	.9938	.9889	.9802	.9649	.9380	.8910	.8092	.6674	.4222						
27.20	.9967	.9940	.9892	.9807	.9657	.9392	.8928	.8115	.6700	.4245						
27.40	.9968	.9942	.9896	.9813	.9665	.9405	.8945	.8138	.6727	.4268						
27.60	.9969	.9944	.9899	.9818	.9673	.9417	.8962	.8161	.6753	.4291						
27.80	.9971	.9946	.9902	.9823	.9681	.9428	.8979	.8183	.6779	.4314						
28.00	.9972	.9948	.9905	.9828	.9689	.9440	.8995	.8205	.6805	.4337						
28.20	.9973	.9950	.9908	.9833	.9697	.9451	.9011	.8226	.6831	.4359						
28.40	.9974	.9952	.9911	.9838	.9704	.9462	.9027	.8248	.6856	.4382						
28.60	.9975	.9954	.9914	.9842	.9711	.9473	.9043	.8269	.6881	.4404						
28.80	.9976	.9955	.9917	.9847	.9718	.9484	.9058	.8290	.6906	.4427						
29.00	.9977	.9957	.9920	.9851	.9725	.9494	.9073	.8310	.6931	.4449						
29.20	.9978	.9959	.9922	.9855	.9732	.9504	.9088	.8331	.6956	.4471						
29.40	.9979	.9960	.9925	.9859	.9738	.9514	.9103	.8351	.6980	.4494						
29.60	.9980	.9962	.9927	.9863	.9744	.9524	.9117	.8371	.7004	.4516						
29.80	.9981	.9963	.9930	.9867	.9751	.9534	.9132	.8390	.7028	.4538						

T	PROBABILITY OF WAIT LESS THAN OR EQUAL TO T										
	.90	.91	.92	.93	UTILIZATION		.94	.95	.96	.97	.98
30.00	.9981	.9964	.9932	.9871	.9757	.9543	.9146	.8410	.7052	.4559	
30.20	.9982	.9966	.9934	.9875	.9763	.9552	.9159	.8429	.7076	.4581	
30.40	.9983	.9967	.9936	.9878	.9768	.9561	.9173	.8448	.7099	.4603	
30.60	.9984	.9968	.9938	.9882	.9774	.9570	.9186	.8466	.7123	.4625	
30.80	.9984	.9969	.9940	.9885	.9779	.9579	.9199	.8485	.7146	.4646	
31.00	.9985	.9970	.9942	.9888	.9785	.9587	.9212	.8503	.7169	.4668	
31.20	.9985	.9971	.9944	.9891	.9790	.9596	.9225	.8521	.7191	.4689	
31.40	.9986	.9972	.9946	.9894	.9795	.9604	.9237	.8539	.7214	.4710	
31.60	.9987	.9973	.9948	.9897	.9800	.9612	.9250	.8557	.7236	.4731	
31.80	.9987	.9974	.9949	.9900	.9805	.9619	.9262	.8574	.7258	.4752	
32.00	.9988	.9975	.9951	.9903	.9810	.9627	.9273	.8591	.7280	.4773	
32.20	.9988	.9976	.9953	.9906	.9814	.9635	.9285	.8608	.7302	.4794	
32.40	.9989	.9977	.9954	.9909	.9819	.9642	.9297	.8625	.7324	.4815	
32.60	.9989	.9978	.9956	.9911	.9823	.9649	.9308	.8641	.7345	.4836	
32.80	.9990	.9979	.9957	.9914	.9827	.9656	.9319	.8658	.7367	.4857	
33.00	.9990	.9980	.9958	.9916	.9831	.9663	.9330	.8674	.7388	.4877	
33.20	.9990	.9980	.9960	.9918	.9836	.9670	.9341	.8690	.7409	.4898	
33.40	.9991	.9981	.9961	.9921	.9840	.9677	.9351	.8706	.7429	.4918	
33.60	.9991	.9982	.9962	.9923	.9843	.9683	.9362	.8721	.7450	.4939	
33.80	.9992	.9982	.9964	.9925	.9847	.9690	.9372	.8737	.7470	.4959	
34.00	.9992	.9983	.9965	.9927	.9851	.9696	.9382	.8752	.7491	.4979	
34.20	.9992	.9984	.9966	.9929	.9855	.9702	.9392	.8767	.7511	.4999	
34.40	.9992	.9984	.9967	.9931	.9858	.9708	.9402	.8782	.7531	.5019	
34.60	.9993	.9985	.9968	.9933	.9861	.9714	.9412	.8797	.7551	.5039	
34.80	.9993	.9985	.9969	.9935	.9865	.9720	.9421	.8811	.7570	.5059	
35.00	.9993	.9986	.9970	.9937	.9868	.9725	.9430	.8825	.7590	.5079	
35.20	.9994	.9986	.9971	.9939	.9871	.9731	.9440	.8840	.7609	.5099	
35.40	.9994	.9987	.9972	.9941	.9874	.9736	.9449	.8854	.7628	.5118	
35.60	.9994	.9987	.9973	.9942	.9877	.9741	.9457	.8867	.7647	.5138	
35.80	.9994	.9988	.9974	.9944	.9880	.9747	.9466	.8881	.7666	.5157	
36.00	.9995	.9988	.9975	.9945	.9883	.9752	.9475	.8894	.7685	.5177	
36.20	.9995	.9989	.9975	.9947	.9886	.9757	.9483	.8908	.7704	.5196	
36.40	.9995	.9989	.9976	.9948	.9889	.9762	.9492	.8921	.7722	.5215	
36.60	.9995	.9990	.9977	.9950	.9892	.9766	.9500	.8934	.7740	.5234	
36.80	.9995	.9990	.9978	.9951	.9894	.9771	.9508	.8947	.7758	.5253	
37.00	.9996	.9990	.9978	.9953	.9897	.9776	.9516	.8959	.7776	.5272	
37.20	.9996	.9991	.9979	.9954	.9899	.9780	.9523	.8972	.7794	.5291	
37.40	.9996	.9991	.9980	.9955	.9902	.9785	.9531	.8984	.7812	.5310	
37.60	.9996	.9991	.9981	.9957	.9904	.9789	.9539	.8997	.7829	.5329	
37.80	.9996	.9992	.9981	.9958	.9906	.9793	.9546	.9009	.7847	.5348	
38.00	.9996	.9992	.9982	.9959	.9909	.9797	.9553	.9021	.7864	.5366	
38.20	.9997	.9992	.9982	.9960	.9911	.9802	.9561	.9032	.7881	.5385	
38.40	.9997	.9992	.9983	.9961	.9913	.9806	.9568	.9044	.7898	.5403	
38.60	.9997	.9993	.9983	.9962	.9915	.9809	.9575	.9056	.7915	.5422	
38.80	.9997	.9993	.9984	.9963	.9917	.9813	.9581	.9067	.7932	.5440	
39.00	.9997	.9993	.9985	.9965	.9919	.9817	.9588	.9078	.7948	.5458	
39.20	.9997	.9994	.9985	.9966	.9921	.9821	.9595	.9089	.7965	.5477	
39.40	.9997	.9994	.9986	.9966	.9923	.9824	.9601	.9100	.7981	.5495	
39.60	.9997	.9994	.9986	.9967	.9925	.9828	.9608	.9111	.7997	.5513	
39.80	.9998	.9994	.9986	.9968	.9927	.9831	.9614	.9122	.8013	.5531	

T	PROBABILITY OF WAIT LESS THAN OR EQUAL TO T									
	.90	.91	.92	.93	UTILIZATION					
	.94	.95	.96	.97	.98	.99				
40.00	.9998	.9994	.9987	.9969	.9929	.9835	.9620	.9132	.8029	.5549
40.20	.9998	.9995	.9987	.9970	.9930	.9838	.9626	.9143	.8045	.5566
40.40	.9998	.9995	.9988	.9971	.9932	.9841	.9632	.9153	.8061	.5584
40.60	.9998	.9995	.9988	.9972	.9934	.9845	.9638	.9163	.8076	.5602
40.80	.9998	.9995	.9988	.9973	.9935	.9848	.9644	.9174	.8092	.5620
41.00	.9998	.9995	.9989	.9973	.9937	.9851	.9650	.9183	.8107	.5637
41.20	.9998	.9996	.9989	.9974	.9938	.9854	.9655	.9193	.8122	.5655
41.40	.9998	.9996	.9990	.9975	.9940	.9857	.9661	.9203	.8137	.5672
41.60	.9998	.9996	.9990	.9976	.9941	.9860	.9666	.9213	.8152	.5689
41.80	.9998	.9996	.9990	.9976	.9943	.9862	.9672	.9222	.8167	.5707
42.00	.9998	.9996	.9991	.9977	.9944	.9865	.9677	.9232	.8182	.5724
42.20	.9999	.9996	.9991	.9978	.9945	.9868	.9682	.9241	.8196	.5741
42.40	.9999	.9996	.9991	.9978	.9947	.9871	.9687	.9250	.8211	.5758
42.60	.9999	.9997	.9991	.9979	.9948	.9873	.9692	.9259	.8225	.5775
42.80	.9999	.9997	.9992	.9979	.9949	.9876	.9697	.9268	.8240	.5792
43.00	.9999	.9997	.9992	.9980	.9950	.9878	.9702	.9277	.8254	.5809
43.20	.9999	.9997	.9992	.9981	.9952	.9881	.9707	.9285	.8268	.5825
43.40	.9999	.9997	.9992	.9981	.9953	.9883	.9712	.9294	.8282	.5842
43.60	.9999	.9997	.9993	.9982	.9954	.9885	.9716	.9303	.8295	.5859
43.80	.9999	.9997	.9993	.9982	.9955	.9888	.9721	.9311	.8309	.5875
44.00		.9997	.9993	.9983	.9956	.9890	.9725	.9319	.8323	.5892
44.20		.9997	.9993	.9983	.9957	.9892	.9730	.9327	.8336	.5908
44.40		.9998	.9994	.9984	.9958	.9894	.9734	.9336	.8349	.5925
44.60		.9998	.9994	.9984	.9959	.9897	.9738	.9344	.8363	.5941
44.80		.9998	.9994	.9985	.9960	.9899	.9743	.9351	.8376	.5957
45.00		.9998	.9994	.9985	.9961	.9901	.9747	.9359	.8389	.5974
45.20		.9998	.9994	.9985	.9962	.9903	.9751	.9367	.8402	.5990
45.40		.9998	.9995	.9986	.9963	.9905	.9755	.9375	.8415	.6006
45.60		.9998	.9995	.9986	.9964	.9907	.9759	.9382	.8427	.6022
45.80		.9998	.9995	.9987	.9965	.9908	.9763	.9390	.8440	.6038
46.00		.9998	.9995	.9987	.9966	.9910	.9767	.9397	.8452	.6054
46.20		.9998	.9995	.9987	.9967	.9912	.9770	.9404	.8465	.6069
46.40		.9998	.9995	.9988	.9967	.9914	.9774	.9411	.8477	.6085
46.60		.9998	.9996	.9988	.9968	.9916	.9778	.9419	.8489	.6101
46.80		.9998	.9996	.9988	.9969	.9917	.9781	.9426	.8501	.6116
47.00		.9998	.9996	.9989	.9970	.9919	.9785	.9432	.8513	.6132
47.20		.9999	.9996	.9989	.9970	.9921	.9788	.9439	.8525	.6147
47.40		.9999	.9996	.9989	.9971	.9922	.9792	.9446	.8537	.6163
47.60		.9999	.9996	.9990	.9972	.9924	.9795	.9453	.8549	.6178
47.80		.9999	.9996	.9990	.9973	.9925	.9798	.9459	.8561	.6194
48.00		.9999	.9996	.9990	.9973	.9927	.9802	.9466	.8572	.6209
48.20		.9999	.9997	.9991	.9974	.9928	.9805	.9472	.8584	.6224
48.40		.9999	.9997	.9991	.9974	.9930	.9808	.9479	.8595	.6239
48.60		.9999	.9997	.9991	.9975	.9931	.9811	.9485	.8606	.6254
48.80		.9999	.9997	.9991	.9976	.9932	.9814	.9491	.8617	.6269
49.00			.9997	.9992	.9976	.9934	.9817	.9497	.8628	.6284
49.20			.9997	.9992	.9977	.9935	.9820	.9503	.8639	.6299
49.40			.9997	.9992	.9977	.9936	.9823	.9509	.8650	.6314
49.60			.9997	.9992	.9978	.9938	.9826	.9515	.8661	.6329
49.80			.9997	.9992	.9978	.9939	.9828	.9521	.8672	.6343
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1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50	51	52	53	54	55	56	57	58	59	60
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